

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



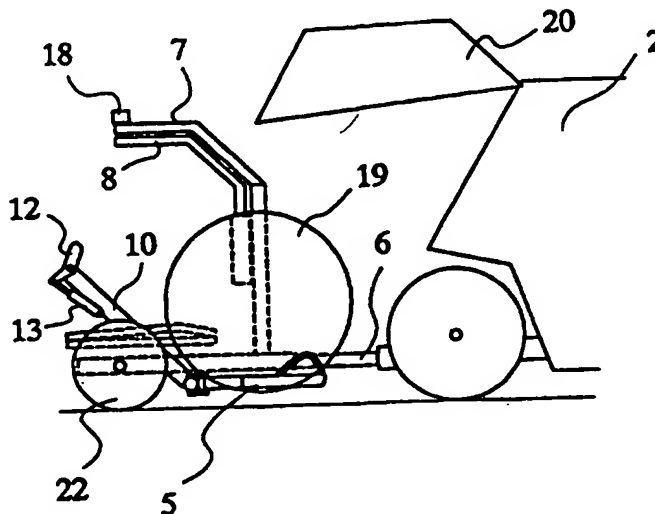
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : <b>A01D 15/07</b>	<b>A1</b>	(11) International Publication Number: <b>WO 96/12399</b> (43) International Publication Date: <b>2 May 1996 (02.05.96)</b>
(21) International Application Number: <b>PCT/FI95/00576</b> (22) International Filing Date: <b>19 October 1995 (19.10.95)</b> (30) Priority Data: <b>944915 19 October 1994 (19.10.94) FI</b> (71) Applicant (for all designated States except US): <b>NHK-KESKUS OY [FI/FI]; Puusepänkatu 5, FIN-13110 Hämeenlinna (FI).</b> (72) Inventor; and (75) Inventor/Applicant (for US only): <b>KORHONEN, Onni [FI/FI]; Kirvestie 18, FIN-00760 Helsinki (FI).</b> (74) Agent: <b>JVP-PALVELU OY; Torikatu 4, FIN-05800 Hyvinkää (FI).</b>		(81) Designated States: <b>AU, CA, NZ, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</b>  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Finnish).</i>

(54) Title: **PROCEDURE AND APPARATUS FOR WRAPPING A FODDER BALE WITH PLASTIC**

(57) Abstract

The invention relates to a procedure for wrapping a straw fodder bale in plastic. A wrapping unit (3) is hitched to a baler (2) and the fodder bale (19) to be wrapped is delivered after the baling directly onto a wrapping table (10), whereupon plastic material is wrapped around the bale. After being wrapped up, the bale is removed from the wrapping table. To allow a bale to be taken up onto the wrapping table, the wrapping table is moved towards the rear of the baler by pulling an extension bar (6) into the drawbar (4) of the wrapping unit.



BEST AVAILABLE COPY

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LJ	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Latvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

PROCEDURE AND APPARATUS FOR WRAPPING A FODDER BALE WITH  
PLASTIC

The present invention relates to a procedure as defined in  
5 the preamble of claim 1 and an apparatus as defined in the  
preamble of claim 3 for wrapping a fresh-fodder bale in  
plastic.

Previously known is a device for wrapping a round bale which  
10 is hitched to a baler and moves on its own wheels and which  
has picking devices for picking up bales from the ground, a  
wrapping table on which the bale is rotated, a wrapping arm  
provided with a plastic roll and a plastic holder and a  
15 plastic cutter. The wrapping unit is hitched to the baler at  
a distance large enough to allow the wrapping arm to rotate  
without hitting the baler in any circumstances. After the  
baler has tied the bale, a bale gate at the rear of the  
baler is opened and the bale is dropped onto the ground,  
20 from where it is lifted by the picking devices of the wrap-  
ping unit onto the wrapping table.

This solution has the drawback that the bale has to be  
dropped to the ground before it is brought onto the wrapping  
table. Foreign matter will stick to the bale and the bale  
25 gets dirty before it is wrapped up. In addition, when work-  
ing on a sloping field, the bale may partly or completely  
roll off the right track, in which case the bale cannot be  
lifted onto the wrapping table by means of the picking de-  
vices. In such cases, the tractor-baler-wrapping unit combi-  
30 nation must be stopped and the bale must be separately moved  
into the correct position to allow it to be lifted onto the  
wrapping table. This is time consuming, leading to a loss in  
capacity.

35 The object of the present invention is to eliminate the  
drawbacks mentioned above and to achieve a procedure and an  
apparatus for wrapping bales in plastic that are reliable  
and easy to use. The procedure of the invention is charac-

terized by what is presented in the characterization part of claim 1. The apparatus of the invention is characterized by the features presented in the characterization part of claim 3. Other embodiments of the invention are characterized by  
5 what is presented in the other claims.

The solution of the invention has the advantage that the bale will catch no dirt from the ground, the fodder quality being thus improved. Another advantage is that the bale cannot 'run away' even on sloping ground, because the bale is  
10 dropped from the baler directly onto the picking device of the wrapping unit. There is also no need to observe how the bale is turned onto the wrapping table or to make separate arrangements to turn the bale because a guard takes care of  
15 keeping the bale on the wrapping table. Moreover, the table can be properly tilted e.g. in a down-hill working situation to permit the bale to be properly moved onto the table, and, because of the guard, there is no fear of the bale falling down over the table. A further advantage is that, at the end  
20 of the working period, the fodder material has been baled and the bales have been wrapped in plastic at the same time and gathered in the right locations. This is possible because the wrapping time is shorter than the baling time, so when a new bale is still being formed, the wrapping of the  
25 previous bale will have been finished and there is still enough time left to move the wrapped-up bale to a desired location along the baling route before the next bale is dropped onto the wrapping unit. An additional advantage is that the bale is wrapped up immediately after baling, thus  
30 ensuring that the fodder will not suffer any detriment from the influence of air. This means improved fodder quality. Also, the bale cannot be soaked by rain between the baling and the wrapping.

35 In the following, the invention is described by the aid of an example by referring to the attached drawings, in which

- Fig. 1 presents the baling and wrapping apparatus at the end of the baling phase in top view.
- Fig. 2 presents the baling and wrapping apparatus during the wrapping phase in top view.
- 5 Fig. 3-6 present different stages of the wrapping process in side view.

The apparatus of the invention is described first to make it easier to understand the procedure. The traction machine  
10 used is a tractor 1. Attached to the rear of the tractor is a baler 2 moving on wheels, which gathers the fodder material from the field and forms it into round bales 19 of a certain size, finally tying the bales. Further, attached to the rear of the baler is a wrapping unit 3 moving on wheels,  
15 by means of which the round bale is wrapped in plastic immediately after the baling. The basic part of the wrapping unit frame consists of a substantially horizontal drawbar 4, which is attached to the rear of the baler. Fixed at right angles to the rear end of the drawbar is a horizontal shaft  
20 with a rotatable wheel 22 at either end. Mounted on the frame in front of the wheels is an overhead supporting arm 7 which rises upwards from the beam and is bent backwards in its upper portion. The supporting arm carries a wrapping arm 8 rotatably mounted at its rear end. The wrapping arm 8 is  
25 bent downwards essentially in the same shape with the overhead supporting arm, in a way that enables the wrapping arm to turn horizontally about its vertical joint without touching the overhead supporting arm. The wrapping arm is rotated by a hydraulic motor 18 mounted on the overhead supporting  
30 arm. The power transmission is implemented e.g. by using a chain and sprockets. The wrapping arm supports a roll of plastic placed in a vertical position at its lower end. The roll is revolved around the fodder bale 19 to be wrapped.

35 Each end of the shaft is provided with a lug for the wrapping table 10, placed close to the wheels 22. The wrapping table is pivoted in the lugs by means of horizontal joints so that it can be tilted forwards and backwards to a suit-

able position to allow a bale to be picked up or removed. The tilting is implemented using hydraulic power means, one end of which is linked to the wrapping table and the other to the frame. The wrapping table 10 is of rectangular form, consisting of two side beams and two end beams. The table is linked to the shaft 20 by joints placed in the side beams. The machine has two horizontal rotating rollers 17 linked to the side beams by bearings placed at the ends of the rollers, the rollers being mounted at right angles to the side beams. In addition, the machine is provided with at least one belt 16 stretched around the rotating rollers so that when a fodder bale is on the belt, it will rotate along with the belt while at the same time the belt forms a concave pocket in which the fodder bale remains well in place during the wrapping operation. The driving energy for the rotating rollers is obtained from a hydraulic motor mounted on the wrapping table. Moreover, the rear edge of the table is provided with a guard 11 designed to prevent the bale from falling off the table, mounted transversely to the direction of motion of the bale and attached to the table by its ends by means of turnable levers 12. The levers 12 are turned by means of a hydraulic cylinder 13 linked at its first end to the wrapping table 10 and to the lever 12 at its other end.

25 The machine is provided with picking devices 5, mounted on each front corner of the wrapping table by means of a joint. The position of the joint is so selected that, when the table 10 is inclined to its extreme position to pick up a bale, the joint is in an essentially vertical position, so that the picking device turning about the joint lies near the ground, rotating in an essentially horizontal plane, i.e. in practice parallel to the ground surface. This arrangement allows bales of different diameters to be handled by the same apparatus. The turning movement of the picking devices is produced by means of hydraulic power units 15, which are connected via joints to the picking devices 5 by one end and by the other end to lugs attached to the table 10.

The drawbar 4 has a telescoping structure, having inside it an extension bar 6 which forms an extension of the drawbar in the same direction with the latter and is attached to the rear of the baler. The drawbar is moved in relation to the extension bar by means of a hydraulic cylinder 9 attached by one end to the frame of the wrapping unit and by the other end to the extension bar 6. By moving the drawbar, the wrapping unit is drawn close up to the rear of the baler just before the bale is dropped from the baler onto the wrapping unit to avoid dropping the bale to the ground. After the bale has been dropped onto the wrapping unit, the wrapping unit is pushed farther away from the baler by means of the hydraulic cylinder 9 and the wrapping process is started. Pushing the wrapping unit to a distance from the baler eliminates the risk of the wrapping arm hitting the rear of the baler e.g. when the working combination is turning.

With the procedure of the invention, the bale handling process is as follows: The operating cycle starts from the situation illustrated by Fig. 1. In this situation, the baler has nearly finished the baling process and the tying of the bale on the baler is beginning. The solution of the invention uses logic control such that when the tying is started, the hydraulic cylinder 9 simultaneously begins to draw the wrapping unit 3 closer to the rear of the baler 2. The wrapping arm 8 is in its standby position below the overhead supporting arm 7 and the picking devices 5 are also in a standby position with their free ends pointing towards the rear of the baler. In addition, the operation of the guard 11 is so synchronised with that of the wrapping table and picking devices that when the table is tilted backwards beyond its horizontal position e.g. when working on a downhill slope, the guard is in a vertical position, preventing the bale from falling down from the wrapping table. When the table returns to the horizontal position, the guard also moves down out of the way of the wrapping arm before wrapping is started. The free end of the plastic wrapping 21 is

- held fast on the plastic cutter 14 while the other end is in the plastic roll placed at the lower end of the wrapping arm. Just before the bale is dropped down, the wrapping table is tilted towards the baler, the picking devices forming a support for the bale falling down from the baler between the baler and the wrapping unit. In the next phase, illustrated by Fig. 3, the bale gate 20 is opened, whereupon the bale is dropped onto the picking devices 5.
- Once the bale has been dropped onto the picking devices, the bale is recognised by means of detectors and the wrapping table 10 is turned to its horizontal position as illustrated by Fig. 2, 4 and 5, the bale gate is closed and the wrapping table is drawn farther away from the rear of the baler by means of the hydraulic cylinder 9 and the picking devices 5 are turned in against the front edge of the wrapping table to keep them out of the way of the wrapping arm. At the same time, the combination is driven on and the baler starts forming a new bale from straw gathered from the field. When the wrapping table is in its rear position, farthest away from the rear of the baler, and the bale is on the wrapping table, a detector detects the position and situation for the logic control and the wrapping phase is started by rotating the bale by means of the belts 16 and revolving the wrapping arm 8 around the bale, which is thus wrapped in plastic 21.

- At the beginning of the wrapping phase, the rotation of the bale is slow during one revolution and is then accelerated slowly to avoid tearing the plastic during the initial jerk. After this, wrapping is continued through a number of revolutions set in the logic control and identified from the revolutions of the wrapping arm by means of a revolution counter. According to the logic control, the rotation of the bale is again slowed down during the last revolution to avoid stopping the rotation too abruptly and to allow the wrapping arm to be gently locked in its standby position.



After the bale has been wrapped, the press arm of the plastic cutter 14 is lifted up according to the logic control and the wrapping arm is moved to its standby position in such a way that, during the last revolution, the plastic goes around the press arm of the plastic cutter. The press arm is turned down again, crumpling the plastic in the direction of the plane of the plastic. The arm compresses the plastic into a bunch against a press back stop and cuts the plastic so that the end of the plastic remains gripped between the press back stop and the plastic roll on the wrapping arm as illustrated by Fig. 6, to be ready for the next bale. Once the plastic has been severed, the bale is free to be dropped down from the wrapping table. The baling phase takes a longer time than the wrapping phase, so the baling process is continued and the newly wrapped bale is transported on the wrapping unit to a suitable storage area. When a suitable location is reached, the wrapping table is tilted backwards as shown in Fig. 6, the guard 11 is turned down to make way for the bale and the bale is dropped down off the wrapping table. After this, the wrapping table is turned back into its horizontal position and a new working cycle can begin.

It is obvious to a person skilled in the art that the invention is not restricted to the example described above, but that it may be varied within the scope of the following claims. Thus, instead of having two picking device, the machine may have only one picking device, turnably mounted on one of the front corners of the wrapping table. The picking device may also consist of a rectangular frame or plate placed at the middle of the table edge. Moreover, use of the wrapping unit is by no means limited to operation after a baler, but the same wrapping unit can also be used to pick up bales from the ground and by hitching it directly to a tractor or other hauling apparatus. The logic control of the system of the invention is so implemented that the wrapping operation after baling and tying of the bale takes place completely automatically and the wrapping is performed by

using commands entered into the logic control system and detectors mounted on the wrapping unit, without separate work contribution by the operator of the apparatus. The operator can interrupt the operation of the automatic system and perform the wrapping manually if required by the situation.

## CLAIMS

1. Procedure for wrapping a bale of hay or straw, such as a straw fodder bale, in plastic, in which procedure a wrapping unit (3) has been hitched to a baler (2) and the fodder bale (19) to be wrapped is delivered after the baling onto a wrapping table (10) and plastic material is wrapped around the bale, which is removed from the wrapping table after it has been wrapped up, characterized in that the operation of wrapping the bale in plastic comprises at least the following stages:

- to allow a bale to be taken up onto the wrapping table (10), the wrapping table is tilted towards the rear of the baler so that the wrapping table edge which is closer to the baler lies lower down, close to the ground surface
- the wrapping table is moved towards the rear of the baler
- picking devices (5) designed to lift the bale are turned to a suitable position to make them ready to receive the bale
- the bale is dropped onto the picking devices and the wrapping table is turned back into a substantially horizontal position, and
- the wrapping table is moved to a distance from the rear of the baler and the bale is wrapped in plastic, whereupon the bale is removed from the wrapping table.

2. Procedure according to claim 1 for wrapping a straw fodder bale in plastic, characterized in that, in order to move the wrapping table towards the rear of the baler, the wrapping unit (3) is moved towards the baler by pulling an extension bar (6) of the wrapping unit into its drawbar (4), thereby reducing the distance between the wrapping unit and the rear of the baler.

35

3. Apparatus for wrapping a bale of hay or straw, such as a straw fodder bale, in plastic, comprising a wrapping unit (3) hitched to a baler and having a frame part, a drawbar

- (4) fixed to the frame part and wheels (22), a wrapping table (10) so mounted with joints that it can be tilted with respect to the frame part, at least one picking device (5) for picking up a bale onto the wrapping table and a wrapping unit for wrapping plastic material around the bale, characterized in that the drawbar (4) of the wrapping unit (3) is of a design allowing variation of the length of the drawbar by means of an extension bar (6).
4. Apparatus according to claim 3, characterized in that it comprises a hydraulic cylinder (9) connected between the drawbar (4) and the extension bar (6) and so fitted in a logic control system that the start of the tying phase in the baler activates the hydraulic cylinder (9) to draw the wrapping unit (3) towards the rear of the baler, the subsequent stages of the wrapping operation being performed under the control of the logic control system.
5. Apparatus according to claim 3 or 4, characterized in that the rear edge of the wrapping table (10) is provided with a hydraulically operated guard (11) designed to prevent the bale from falling down from the wrapping table, which guard, when necessary, is raised to its blocking position when a bale is being taken onto the table.

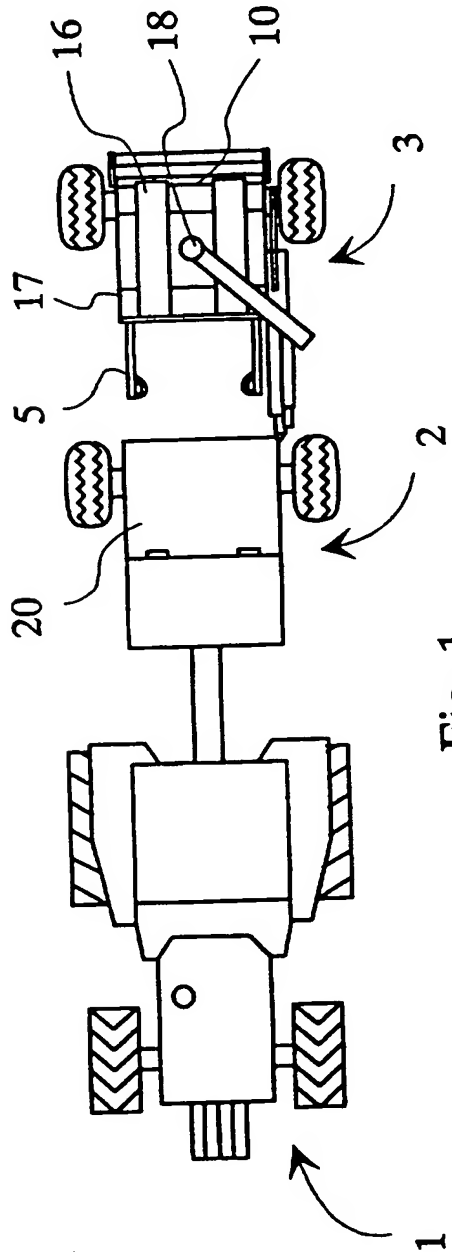


Fig. 1

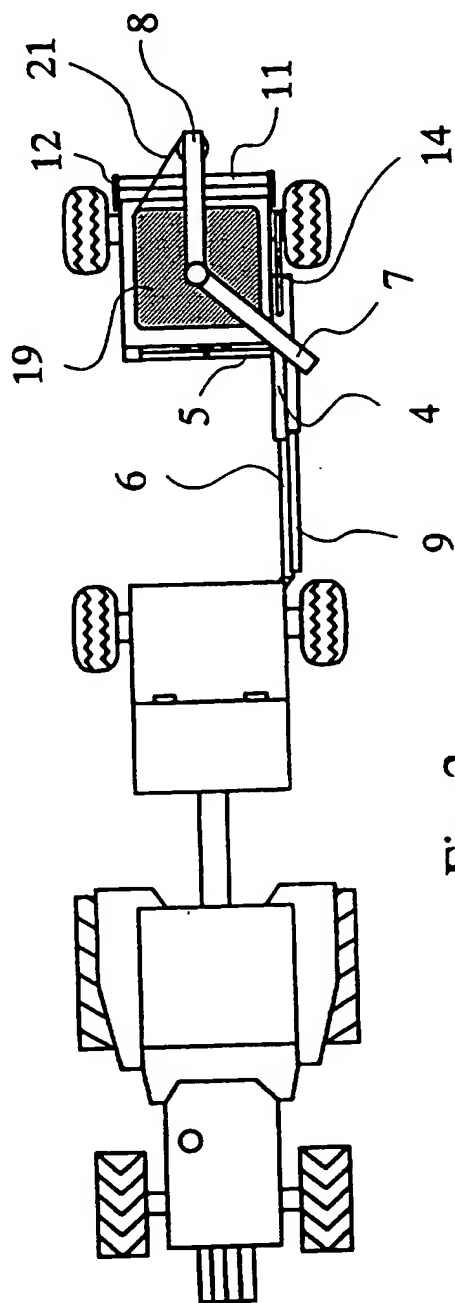


Fig. 2

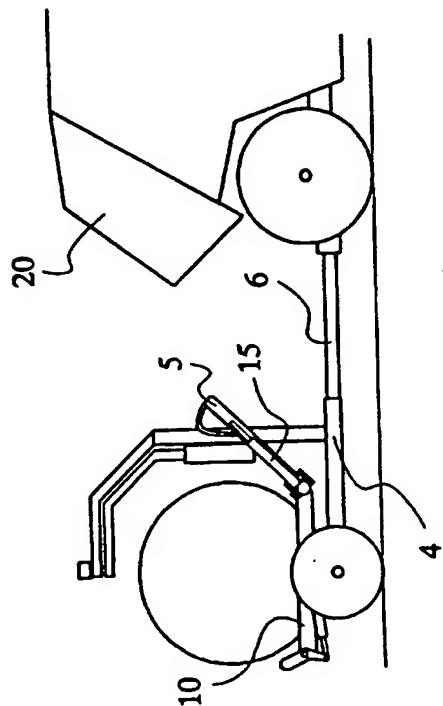


Fig. 4

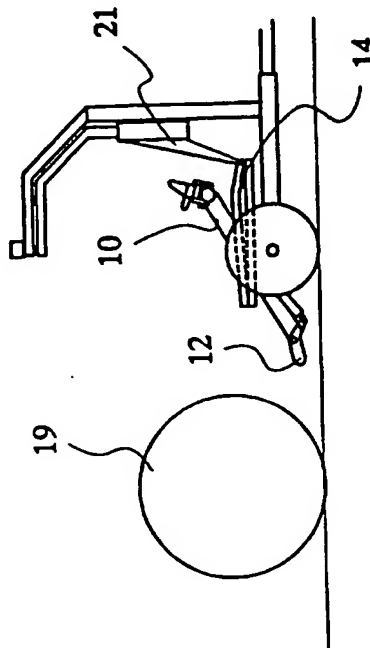


Fig. 6

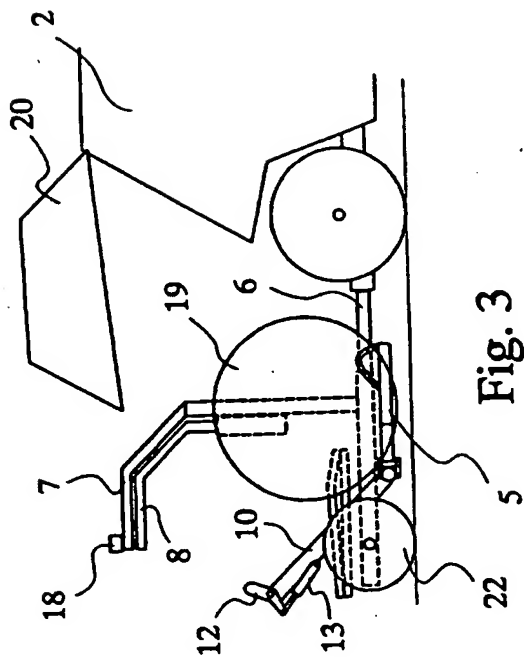


Fig. 3

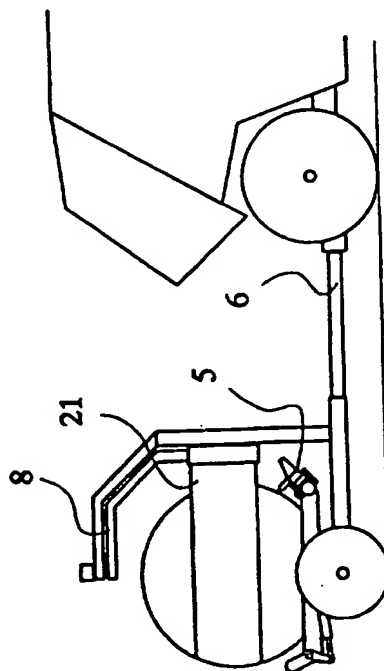


Fig. 5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 95/00576

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A01D 15/07

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2658985 A1 (ETABLISSEMENTS BUGNOT (SOCIEE à RESPONSABILITE LIMITEE)), 6 Sept 1991 (06.09.91)	1-4
Y	--	5
Y	DE 4208091 A1 (SCHENKE, HELMUT), 7 October 1993 (07.10.93)	5
A	DE 4120733 C2 (DEERE & CO ET AL), 11 May 1994 (11.05.94), column 6, line 1 - line 9	
A	EP 0110110 A1 (DARIO MANULIS S.P.A.), 13 June 1984 (13.06.84), claim 9	



Further documents are listed in the continuation of Box C.



See patent family annex.

- \* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "B" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

25 January 1996

Date of mailing of the international search report

12 -02- 1996

Name and mailing address of the ISA/  
 Swedish Patent Office  
 Box 5055, S-102 42 STOCKHOLM  
 Facsimile No. +46 8 666 02 86

Authorized officer

Magnus Thorén  
 Telephone No. +46 8 782 25 00

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 95/00576

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0336739 A2 (WALTON, JOHN DOWSON), 11 October 1989 (11.10.89), column 3, line 3 - line 4; column 5, line 25 - line 28  --	
A	EP 0499285 A1 (NHK-KESKUS OY), 19 August 1992 (19.08.92), column 3, line 45 - column 4, line 14  --	
A	EP 0543145 A2 (BUSATIS-WERKE GMBH & CO. KG), 26 May 1993 (26.05.93)  -- -----	



**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

05/01/96

International application No.  
PCT/FI 95/00576

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR-A1-	2658985	06/09/91	EP-A- 0424192	24/04/91
DE-A1-	4208091	07/10/93	NONE	
DE-C2-	4120733	11/05/94	NONE	
EP-A1-	0110110	13/06/84	SE-T3- 0110110 DE-A- 3376312 US-A- 4685270 JP-A- 59093610	26/05/88 11/08/87 30/05/84
EP-A2-	0336739	11/10/89	DE-T- 68907513 US-A- 5048271	16/12/93 17/09/91
EP-A1-	0499285	19/08/92	NONE	
EP-A2-	0543145	26/05/93	CA-A- 2081839 DE-A- 4138499 JP-A- 6070631	23/05/93 27/05/93 15/03/94

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☒ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**